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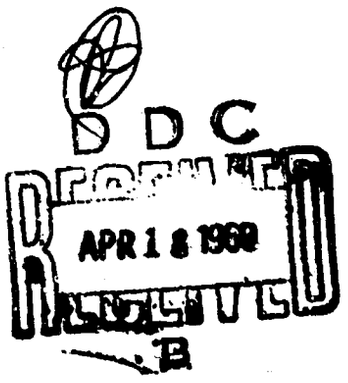


DEPARTMENT OF THE ARMY
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# THE RELATIONSHIP OF THE NUMBER OF OLFACTORY CELLS TO THE OLFACTORY THRESHOLD IN THE DOG

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U. S. ARMY
BIOLOGICAL LABORATORIES
FORT DETRICK, FREDERICK, MARYLAND

# THE RELATIONSHIP OF THE NUMBER OF OLFACTORY CELLS TO THE OLFACTORY THRESHHOLD IN THE DOG

(Following is the translation of an article by Walter Neuhaus and Adam Mueller, Zoological Institute of the University of Erlangen, published in the German Language periodical Naturwiss, 1954, 41; page 20. Translation performed by C. L. Lust.)

During a study on the olfactory sensitivity of dogs for fatty acids, it was found that in a stimulus to reach threshhold probably one vapor molecule was enough to stimulate the sensitive brain cell. Since the background work for this was rather uncertain it seemed advantageous to exactly determine the number of olfactory cells of the dog. After a number of technical and methodologic difficulties (which have been reported in detail elsewhere) we successfully quantitated the cell count in a seris of sections with the aid of tryptan -blue. With the aid of a standardized counting and calculation method we then determined the number of olfactory cells in a Dachshund in respect to their regional distribution. It was found that the cell density was very uniform. In the area of border of the respiratory epithelium the cells are rather loose. In this way a narrow strip of olfactory cells surround the entire olfactory field. This field has a large surface area in the dog (especially designed in the musculature of dogs.) It is a closed area which reaches about to the middle of the nasel cavity (septum) in the front, and all the way into the back.

125,000,000 olfactory cells were counted in the entire epithelium of both halves of the nose. They distributed themselves from front to back so that the maximum number of cells were concentrated in the middle region. The cell density in this area, for an olfactory area of 75 $cm^2$ is 16,600 cells per $mm^2$. After the relatively small variation of cell density was determined, it was possible to ascertain the cell number in other breeds than Dachshund. For a German Shephard 224,800,000 olfactory cells were found in an area of 150 $cm^2$; for a Fox Terrier 147,000,000 in an area of 83 $cm^2$.

Based on the calculated cells it is possible to estimate more precisely the number of vapor molecules needed to reach the threshhold for the brain cells to be activated. The size of the breath during smelling is required. For a Fox Terrier (12 kg) it is estimated that during quiet breathing (no exercize) 75 $cm^3$ of air is inhaled in every breath. During exertion considerably more. Since this value could only be interpoleted from the literature rather imprecisely (3), the volume of a breath for the animal was measured with a suitable spirometer (gasometric analysis). A funnel with rubber was used as a mask (without annoying animal) placed over the snout to collect breath. In shallow breaths 50-70 $cm^3$ per breath were measured, in deep breath 130-200 $cm^3$. In determining threshhold, the dog usually breathed deep 100-150 $cm^3$.

For Butyric acid $9 \times 10^3$ molecules/ml was threshhold. If all molecules inhaled into the nose reached the olfactory epithelium and all brain cells reacted about 62 sensitive cells for each molecule reacted ($147 \times 10^6 \div 9 \times 10^3 \times 200$). The largest portion of the molecules did not reach the sensitive olfactory cells.

1.) All surfaces of the nose are covered with a liquid membrane which absorbs olfactory materials. 2.) Most air streams past the olfactory sensors in the shortest way to the lung in deep breathing. In these areas materials are also absorbed so that in exhaling the air is largely free from "olfactory" molecules. 3.) In the smell (olfactory) field many, but not all, molecules diffuse along the olfactory villae (hairs). If all these factors are considered it is unlikely that more than one molecule is available per sensor-cell. This means that the olfactory sensor cells are stimulated via a mono-molecular reaction.

Even though calculations earlier were imprecise the facts still holds if the number of sensor cells and the molecular amount are proportionally the same. The present work corra in a precise manner the earlier calculations. The facts are secure.

References

1. Neuhaus, Z., Z. vergl. Physiol. 35, 527 (1954)
2. Mueller, A., Diss. Erlangen, 1954
3. Loewy, A., Tabulae biol. (Den Haag) 3, 461 (1926)